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United States Department of Agriculture,  
**BUREAU OF FORESTRY,**

GIFFORD PINCHOT, Forester.

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**TIMBER PRESERVATION AND TIMBER TESTING AT THE LOUISIANA  
PURCHASE EXPOSITION.**

The Bureau of Forestry has erected an extensive plant on the grounds of the St. Louis Exposition for carrying on investigations of the methods for preserving timber, and of what influence various preservative processes have upon the strength of the timber. This plant is located on the out-of-door mining tract in a place called "The Gulch" near Intramural Station No. 13. It consists of two separate and distinct parts—a complete timber-preserving plant and a timber-testing station.

The preserving plant is in every respect a small commercial plant consisting of a high-pressure impregnating cylinder capable of withstanding at least 600 pounds pressure per square inch, with the necessary vacuum and pressure pumps, storage cylinders, and reservoirs. It has been loaned to the Bureau of Forestry by the Ayer & Lord Tie Company and the Allis Chalmers Company, of Chicago, Ill.

The timber-testing station consists of one large impact machine, and a smaller 30,000-pound Olsen testing machine. A power saw and planer are installed with the timber-testing machines, so that all test timbers will be cut and planed on the ground. The planer and saw have been loaned for this purpose by the Fay Egan Company of Cincinnati, Ohio, and the motors driving the machinery have been loaned by the Western Electric Company of New York City.

The timber-preserving plant and the timber-testing station are located close to each other, so that after timbers have been treated they may be taken to the testing station without undue labor or loss of time.

The chemicals for the preserving tests have been furnished the Bureau free of charge; the creosote by the Chatfield Manufacturing Company of Cincinnati, Ohio, and the zinc chlorid by the General Chemical Company of Chicago, Ill.

Two timber-test engineers will be employed in connection with the investigations, and the timber-preserving plant has been put in charge of an experienced timber-treating engineer with several assistants from one of the large preserving plants of the West.

**PLAN OF WORK.**

The work, which began the first part of September, will be pursued along two distinct lines: First, to determine what influence, if any, the various preservative processes, as at present used, have upon the strength

of the wood fiber, and, second, to investigate certain leading questions pertaining to the wood-preserving industry.

#### 1. INVESTIGATIONS TO DETERMINE INFLUENCE OF PRESERVATIVE PROCESSES UPON STRENGTH OF FIBER.

Although chemically treated timbers have been in use in the United States and Europe for a great many years, there is little accurate information as to the influence which the various preservative processes have upon the strength of the wood fiber. In outlining the plan for these tests two divisions were made dealing respectively with the preliminary processes of steaming, superheating, vacuum, etc., commonly employed in the preservation of wood, and the influence of the preserving materials themselves. One of the most important questions in this connection will be to determine exactly what influence high temperatures, whether of dry or moist heat, have upon the strength of the wood fiber.

#### MATERIAL FOR TESTS.

The material selected for these tests will be cut in the form of railroad ties, as these are most readily obtainable. The ties to be treated will be 11 feet long. One section of the tie 8 feet long will be put through the particular treatment, and the other section 3 feet long will be used for control-test pieces.

#### TEST PIECES TO BE TAKEN FROM THE TIES.

Test pieces 2 inches by 2 inches in cross-section and 30 inches long, will be cut from the sections, according to directions outlined below.

#### MANNER OF TAKING OUT TEST PIECES.

Four test pieces will be taken from the control section, and eight from the treated section of the tie, one side of the test piece coinciding with the direction of the annual rings and the other at right angles to it. The test pieces for compression tests will be 2 inches by 2 inches in cross-section and 4 inches long, and will be taken from the ends of the test pieces which have been used in flexure tests.

#### METHOD OF TEST.

The impact-flexural test will be performed by dropping a given weight from heights which increase by a constant increment. The factor which fixes the strength of the test piece will be that height of blow following which the test piece fails to recover from the effects of the blow. The deflection and rebound following the blow next preceding this last-mentioned blow will also be noted.

The static-flexural test will be performed in the ordinary manner at present prevailing in the timber tests of the Bureau of Forestry.

The impact-compression test will be made in a similar manner to the



impact-flexural test. The effect on the shearing strength will also be determined. The shearing-test pieces will be 2 inches by 2 inches, with a projecting head.

The static-compression test will simply determine the crushing strength of the sample.

From each test piece, immediately after test, will be cut a half-inch disk from the center of the span for moisture determination, and immediately adjoining thereto a test piece for chemical analysis. The latter will be cut into shavings, put into a glass-top bottle, and labeled. These samples will be weighed immediately upon being taken out of the test piece.

#### OUTLINE OF THE SCOPE OF THE WORK.

##### STATEMENT OF THE PROBLEM.

The problem may be stated as follows:

(1) To determine the effect of the preliminary processes, such as steaming, on the mechanical properties of the timber.

(2) To determine the effect of preservatives on the strength of timber, eliminating the effect of the preliminary processes.

In order to determine the effect of these factors the programme is divided into two parts—part 1, the effect of the preliminary process, and part 2, the effect of preservatives. The arrangement of the programme is shown in Exhibit A.

Part 1 will be carried out in advance of part 2. From the results obtained from part 1 the exact arrangement of the details of part 2 can be made. The programme will be confined to sapwood.

The effects of the preliminary process will be determined only on green timber. Both green and seasoned timber will be used in determining the effect of preservatives. The preservative processes to be investigated will for the present include only creosote and zinc chlorid.

##### SPECIES TO BE INVESTIGATED.

Loblolly pine will be the main species to be tested first. A minor series of tests will be conducted on red oak at the same time that the tests on loblolly pine are in progress. Should the time allow, other species will be investigated.

##### NUMBER OF INDIVIDUAL TESTS INCLUDED IN AN AVERAGE RESULT.

Eight individual tests will suffice for an average result.

##### PROGRAMME.

The serial numbers used will be determined as follows:

Each run will receive a serial number to be specified by treating section.

The run number and tie number will be specified by the engineer of treating plant.

In any one run there will be four ties marked *a*, *b*, *c*, and *d*.

In any tie the test piece will be taken out according to the following sketch :

			3'		8'				
			Control		Tie to be treated				
	1		1		5		9		
4		2	2		6		10		10
	3		3		7		11		11
			Part to be cut into test pieces after treatment.				Part to be cut into test pieces which will be resoaked.		

The test pieces from each tie will be marked as follows: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. The pieces marked 1 and 2 will be used for control-impact tests, and the pieces marked 3 and 4 will be used for control-static tests. The pieces marked 5 and 6 will be used for impact tests after the completion of the run through the treating cylinder. The pieces marked 7 and 8 will be used for static tests after the completion of the run through the treating cylinder. The pieces marked 9 to 12 will be similarly tested after the completion of the run through the treating cylinder, but will be resoaked before test to bring them back to the degree of moisture found in the control-test pieces.

Test pieces for compression tests on the end of the grain, and also the test pieces for shear, will be cut from the ends of the flexure-test pieces. In part 2 of the programme the test pieces which have been subjected to the action of the preservative will be numbered as above except that a letter will be used to indicate creosote or zinc chlorid.

The experiments on any one run will thus be based on four ties which will yield twenty-four tests per tie, as follows:

- 2—impact—flexure—control.
- 2—impact—comp—control.
- 2—static—flexure—control.
- 2—static—comp—control.
- 2—impact—flexure—treated.
- 2—impact—comp—treated.
- 2—static—flexure—treated.
- 2—static—comp—treated.
- 2—impact—flexure—resoaked.
- 2—impact—comp—resoaked.
- 2—static—flexure—resoaked.
- 2—static—comp—resoaked.

## 2. TIMBER-PRESERVING PROBLEMS.

While the attention of the preserving plant will be chiefly directed toward the tests dealing with the influence of preservatives on the



strength of timber, it is proposed to conduct, as far as the time will allow, a series of tests dealing with some of the following questions:

*First*—The penetration of salts into dry and green wood subjected to steaming.

These tests will be conducted largely with red oak and loblolly pine, using zinc chlorid and creosote as preservatives, to determine whether it will be more advisable to steam green timber for various lengths of time and at various pressures before treatment, or whether a treatment of air-seasoned or artificially-seasoned timber without steaming will prove more economical. At the present time almost all treating plants give the timber a preliminary steaming in order to facilitate the entrance of the preservatives. The timber will be left in the treating cylinder for various lengths of time under various steam pressures.

*Second*—Creosoting processes.

Investigations will be conducted to determine the comparative retaining power of various kinds of wood treated with creosote. The problem is of particular interest in connection with timbers exposed to the air, where it is desirable to thoroughly impregnate such timbers with the least possible amount of oil, so that it shall not drip from the wood after being exposed to atmospheric influences.

In this connection tests will be made to determine the influence of alternating air pressures, the use of superheated steam in bringing about the drying out of the wood, and the possible extraction of excessive quantities of the creosoting oil from the timbers after treatment. It is proposed likewise to investigate the relative penetration of creosote and zinc chlorid under similar pressures into different kinds of timber.

*Third*—Influence of season of cutting on treatment.

Tests will be conducted with timbers which have been cut during various seasons of the year to determine whether the penetration of salts into timber cut at various seasons is in any way influenced by the cutting season. For this purpose ties which have been under actual observation by members of the Bureau of Forestry for twelve or more months, will be shipped from various parts of the West.

#### DENDRO-CHEMICAL INVESTIGATIONS.

In cooperation with the timber-testing and timber-preserving investigations a series of experiments will be made to determine the actual amounts of preservatives taken up by the wood during the various treating operations. Special attention will be paid to the various grades of creosote oil with a view of developing a uniform specification for creosote oil and methods of analysis, both before treatment and after the preservatives have penetrated the wood. A special laboratory has been equipped for this purpose, and three chemists will be at work there.

TREATMENT OF FENCE POSTS.

Two small treating plants have been put up for the purpose of making experiments as to methods for treating the butts of fence posts. It is expected to treat red oak, beech, black oak, loblolly pine, and various other inferior woods in such a way that these timbers may have their lasting powers increased three and fourfold.

EXHIBIT A.

The following is a statement of the runs to be made :

PART 1.

Series number.	Condition of tie.	Steam.	Time.	Pressure.	Super-heated.	Tem-perature.	Time in vacuum super-heated.	Tem-perature.
			<i>Hours.</i>	<i>Pounds.</i>	<i>Hours.</i>	°	<i>Hour.</i>	°
A-----	Green-----	Live-----	1	20	-----	-----	-----	-----
B-----	Green-----	Live-----	4	20	-----	-----	-----	-----
C-----	Green-----	Live-----	4	30	-----	-----	-----	-----
D-----	Green-----	Live-----	4	40	-----	-----	-----	-----
E-----	Green-----	Live-----	4	50	-----	-----	-----	-----
F-----	Green-----	Live-----	10	20	-----	-----	-----	-----
G-----	Green-----	Live-----	4	20	-----	-----	-----	-----
H-----	Green-----	Live-----	4	20	2	300	-----	-----
I-----	Green-----	Live-----	4	20	2	400	-----	-----
J-----	Green-----	Live-----	4	20	2	600	1	-----
K-----	Green-----	Live-----	4	50	2	300	-----	-----
L-----	Green-----	Live-----	4	50	2	400	-----	-----
M-----	Green-----	Live-----	4	50	2	600	-----	-----
N-----	Green-----	Live-----	4	-----	-----	-----	1	-----

STRENGTH TESTS AND PRESERVATIVE PROCESSES, WORLD'S FAIR.

PART I.—*Steaming.*

Green timber	Natural.					
	Steamed	Steamed with live steam	4 hours	1 hour at 20 pounds pressure.		
				Using 20 pounds steam pressure	Super- heated 2 hours	Temperature 300° F.
						Temperature 400° F.
					Temperature 600° F.	
				Superheated with vacuum 1 hour.		
				Using 30 pounds steam pressure.		
				Using 40 pounds steam pressure.		
				Using 50 pounds steam pressure	Super- heated 2 hours	Temperature 300° F.
						Temperature 400° F.
Temperature 600° F.						
Superheated with vacuum 1 hour.						
10 hours at 20 pounds pressure.						
Steamed with superheated steam in coil with vacuum.						

PART II.—*Treatments.*

Creosote	{ Green timber with steam treatment selected from above and preservative following.	
	{ Seasoned timber	{ With steam treatment followed by preservatives.
		{ Without steaming—injection of preservatives.
Zinc ehlorid	{ Green timber with steam treatment selected from above and preservative following.	
	{ Seasoned timber	{ With steam treatment followed by preservative.
		{ Without steaming—injection of preservative.





